

What is claimed is:

1. In the cleaning of an integrated circuit substrate, a method for removing by-products of a high-k dielectric dry etch process from the integrated circuit substrate, said method
5 comprising:

contacting the integrated circuit substrate with an aqueous composition comprising an amount, effective for the purpose of (a) hydrogen fluoride, followed by (b) a mixture of hydrogen peroxide with a compound selected from the group consisting of ammonium hydroxide, hydrochloric acid and sulfuric acid.

10 2. The method as recited in claim 1, wherein the aqueous composition comprises from about 0.05 to about 30 percent of hydrogen fluoride based on the volume of the composition.

15 3. The method as recited in claim 1, wherein the aqueous composition comprises from about 0.05 to about 30 percent of ammonium hydroxide based on the volume of the composition.

20 4. The method as recited in claim 1, wherein the aqueous composition comprises from about 0.05 to about 30 percent of hydrogen peroxide based on the volume of the composition.

25 5. The method as recited in claim 1, wherein said cleaning comprises contacting the integrated circuit substrate with the aqueous cleaning composition at a temperature from about 15° C to about 90° C.

30 6. The method as recited in claim 1, wherein said cleaning comprises contacting the integrated circuit substrate with the aqueous cleaning composition from about 10 seconds to about 10 minutes.

7. The method as recited in claim 1, wherein said cleaning further comprises megasonic physical cleaning.

8. The method as recited in claim 1, wherein the by-products of the high-k dielectric dry etch process are Group IVB transition metals.

9. The method as recited in claim 1, wherein the dielectric has a k value of greater than about 10.

10. In the cleaning of an integrated circuit substrate, a method for removing by-products of a high-k dielectric dry etch process from the integrated circuit substrate, said method comprising:

contacting the integrated circuit substrate with an aqueous composition comprising an amount, effective for the purpose of (a) hydrogen fluoride, followed by (b) a mixture of hydrogen peroxide and ammonium hydroxide.

11. The method as recited in claim 10, wherein the aqueous composition comprises from about 0.05 to about 30 percent of hydrogen fluoride based on the volume of the composition.

12. The method as recited in claim 10, wherein the aqueous composition comprises from about 0.05 to about 30 percent of ammonium hydroxide based on the volume of the composition.

13. The method as recited in claim 10, wherein the aqueous composition comprises from about 0.05 to about 30 percent of hydrogen peroxide based on the volume of the composition.

14. The method as recited in claim 10, wherein said cleaning comprises contacting the integrated circuit substrate with the aqueous cleaning composition at a temperature from about 15° C to about 90° C.

5 15. The method as recited in claim 10, wherein said cleaning comprises contacting the integrated circuit substrate with the aqueous cleaning composition from about 10 seconds to about 10 minutes.

16. The method as recited in claim 10, wherein said cleaning further comprises megasonic physical cleaning.

10 17. The method as recited in claim 10, wherein the by-products of the high-k dielectric dry etch process are Group IVB transition metals.

18. The method as recited in claim 10, wherein the dielectric has a k value greater than about 10.

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